Highlights

The quality of mathematics and science education in the United States has been an ongoing concern of scientists, engineers, and decisionmakers. Following World War II, scientists, engineers, and mathematicians expressed grave concerns in the Bush and Steelman reports about the quality of pre-college instruction in their fields as well as the number of students who go on to college and study these subjects. They saw the curriculum as badly out of date, too broad for teachers to master—let alone students—and instruction as too passive for children to develop a genuine understanding of the key concepts and ideas in their fields. The perception of a crisis in education was further created by the launching of Sputnik in 1957 and by the publication of international comparative studies of student achievement starting in the 1970s. Pre-college math and science education is today still a national, state, and local concern. The following highlights point out that some improvements have occurred on a national scale, but that these are not uniform. Additionally, international comparisons show that U.S. achievement is especially low at the end of secondary school, well below the international average.

U.S. Achievement Compared with Other Countries

- **U. S. student achievement in mathematics and science compared least favorably with that of their peers in other countries at the end of high school, was at or above the international average in middle school, and was above the international average in elementary school in the 1995 Third International Mathematics and Science Study (TIMSS).**
- **U.S. students in the final year of secondary school scored below the international average on assessments of general science and mathematics.** On an assessment of general mathematics, students in 14 of 21 nations outperformed U.S. students, and on an assessment of general science, students in 11 of 21 countries outperformed U.S. students. The United States performed better than 2 countries, Cyprus and South Africa, in both subjects.
- **U.S. 12th grade advanced science students performed below 14 of 16 countries on the TIMSS physics assessment. Advanced mathematics students scored below 11 of 16 countries on the advanced mathematics assessment.** Advanced mathematics and science students did not outperform students in any country on either the physics or advanced mathematics assessment.
- **Eighth grade U.S. science students performed above the 41-country international TIMSS average.** They performed at the international average in chemistry and physics, and above average on life sciences, earth sciences, and environmental issues.
- **Eighth grade U.S. mathematics students performed below the 41-country international average overall as well as in geometry, measurement, and proportionality.**
- **The science and mathematics performance of fourth grade students in the United States was among the highest of those countries participating in the TIMSS assessment at that level.** In science, fourth grade students scored well above the international average for 26 countries overall as well as in the four content areas assessed. Fourth grade students scored above the international mean in mathematics overall and in all content areas except measurement.

National Trends in Achievement

- **U.S. students in the 1990s were generally performing better in mathematics and science as measured by the National Assessment of Educational Progress (NAEP) than did their counterparts in the late 1970s.** The "benchmarks" selected for this report are scores on NAEP trends assessment of 200, 250, and 300, respectively, for ages 9, 13, and 17.
- **The science and mathematics achievement of both male and female students has increased in the last two decades at all ages tested (9, 13, and 17).**
- **No significant difference in mathematics performance was observed between boys and girls at ages 9 and 13 between 1978 and 1996.** Differences in mathematics performance for 17-year-old males and females were observed in NAEP between 1978 to 1986, but not between 1990 and 1996.
- **No gender differences in mathematics were observed at any grade in the international assessment administered for the TIMSS.**
- **Gender differences in science achievement continue to exist in the 1996 NAEP for students at ages 13 and 17.** Differences between boys and girls in science achievement in the United States were generally small compared with differences for students in other countries (TIMSS).
- **The percentage of white, black, and Hispanic students that reached the benchmark levels of science achievement at ages 9, 13, and 17 increased between 1977 and 1996.** The change was particularly noteworthy for

9-year-old black students, who increased by 25 percentage points over that period.

♦ **White, black, and Hispanic students in the three age groups demonstrated upward trends for mathematics proficiency between 1978 and 1996.** Differences in achievement levels of racial and ethnic groups persist, however.

Advanced Course Taking by High School Students

♦ **More students took advanced mathematics and science courses in 1994 than in 1982.** More than 90 percent of the high school class of 1994 completed biology, more than one-half completed chemistry, and about one-quarter completed physics. Approximately 70 percent of the class of 1994 completed geometry, 58 percent completed algebra 2, and 9 percent completed calculus.

♦ **Students from racial/ethnic groups that are typically underrepresented in science and mathematics made substantial gains in the proportions taking advanced mathematics and science courses.** For example, the proportion of black students completing chemistry doubled between 1982 and 1994; the completion rate for Hispanic students nearly tripled; and for American Indian/Alaskan Natives, the proportion increased by more than one-half. More students in all racial/ethnic groups completed physics between 1982 and 1994, although the proportion of students from black, Hispanic, and American Indian/Alaskan Native groups remained lower than for white and Asian students in 1994.

Curriculum and Instruction

♦ **Access to technology in schools grew rapidly in the 1990s.** Hand-held calculators are in common use in both U.S. homes and classrooms. Computers are seemingly ubiquitous and Internet connectivity is on the increase. By 1998, nearly all schools reported having at least one computer linked to the Internet and half of individual classrooms had access to the Internet. However, at present, only about one teacher in five felt "very well prepared" to integrate education technology into the subjects they taught.

♦ **A "digital divide" persists in access to technology in schools.** Black and Hispanic students and less affluent students continue to have less access to high-end technology at school.

♦ **Curriculum and textbooks used in U.S. schools are highly repetitive, contain too many topics, and provide inadequate coverage of important topics, according to a curriculum analysis conducted as a part of TIMSS.** Independent judges determined that none of the 9 U.S. science texts that were evaluated and only 6 of the 13 U.S. mathematics texts were satisfactory based on 24 instructional criteria.

♦ **Instruction in U.S. eighth-grade classrooms focuses on development of low-level skills rather than on understanding and provides few opportunities for students to engage in high-level mathematical thinking.** A team of mathematicians found that 13 percent of Japanese lessons in 1995 were judged to be of low quality while 87 percent of lessons from U.S. classrooms were judged to be of low quality.

Teachers and Teaching

♦ **There are few adequate indicators of the quality of teachers to describe teaching in the United States.**

♦ **It is common for students to be taught mathematics and science by teachers who do not hold degrees in these subjects.** For example, a 1996 study showed that more than a third of eighth graders were taught mathematics by teachers who had neither a degree in mathematics nor a degree in mathematics education. This mismatch was even larger in science.

Alternative Forms of Schooling

♦ **Charter schools now serve approximately 170,000 students out of 48 million students in the United States.** From school year 1992/93 to 1997/98, the number of charter schools increased from 2 (in Minnesota) to approximately 1,000 nationwide.

♦ **More low-income students have access to privately funded vouchers and scholarships.** In school year 1992/93, close to 4,100 low-income students in four urban districts received privately funded vouchers or scholarships to attend better schools. In school year 1996/97, approximately 11,000 low-income students in 28 urban districts received private scholarships.

♦ **Increased numbers of parents are choosing to educate their children at home.** Home schooling has increased from an estimated 250,000 to 350,000 nationwide in 1991/92 to approximately 700,000 to 750,000 in 1995/96.